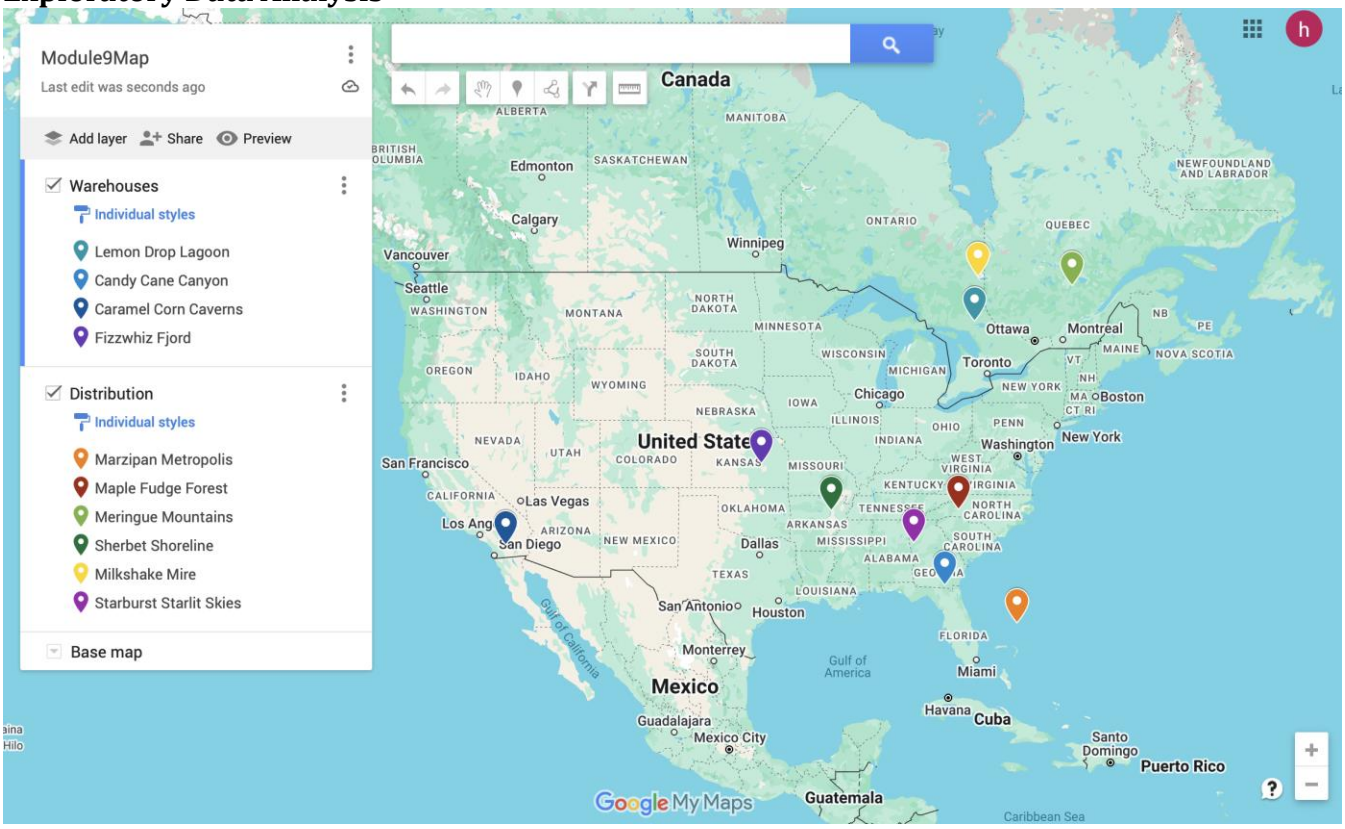
Module 09 – Fixed Charge Problem

Exploratory Data Analysis



Model Formulation

MIN:
21.23X11 + 12.07X12 + 9.31X13 + 21.89X14 + 2.52X15 + 17.6X16 + 8.07X21 + 5.93X22 + 27.31X23 + 13.41X24 +20.52X25 + 5.06X26 + 44.27X31 + 36.95X32+ 58.33X33 + 27.13X34 + 51.54X35 + 31.42X36 + 29.71X41 + 17.91X42 + 33.69X43 + 8.23X44 + 26.3X44 + 26.9X45 + 16.58X46

Subject to:
X11 + X21 + X31 + X41 >= 620
X12 + X22 + X32 + X42 >= 587
X13 + X23 + X33 + X43 >= 800
X14 + X24 + X34 + X44 >= 616
X15 + X25 + X35 + X45 >= 841
X16 + X26 + X36 + X46 >= 565

Constraints
=SUM of Binary <= 2

Model Optimized for Min Costs to Supply DCs

WH v DC >	1	2	3	4	5	6
1	21.37	12.07	9.31	21.89	2.52	17.6
2	8.07	5.93	27.31	13.41	20.52	5.06
3	44.27	36.95	58.33	27.13	51.54	31.42
4	29.71	17.91	33.69	8.23	26.9	16.58

WH v DC >	1	2	3	4	5	6	SUM
1	0	0	800	0	841	0	1641
2	620	587	0	616	0	565	2388
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
SUM	620	587	800	616	841	565	4029
DEMAND	620	587	800	616	841	565	4029

		TOTAL -->	$ 29,171.09	

Binary	Linking Constraints	Possible Cost	Actual Cost
1	-2388	$ 2,224	$ 2,224
1	-1641	$ 2,975	$ 2,975
0	0	$ 2,468	$ -
0	0	$ 2,008	$ -
2			

This model is recommending that to achieve a minimized cost of $29,171.09, the company will have to use warehouses 1 and 2 to have a lower cost associated with each of the distribution centers. Also, both warehouses will not supply to all of the distribution centers.

Model with Stipulation

Please perform 2 out of the 3 scenarios below with a short text description on what changed:

1. *Instead of only being able to open 2 warehouses, what happens to our objective function when we only can open 1 warehouse?*

If you only open 1 warehouse, the effect it will have on the objective function, is it will increase the minimum cost significantly.

WH v DC >	1	2	3	4	5	6
1	21.37	12.07	9.31	21.89	2.52	17.6
2	8.07	5.93	27.31	13.41	20.52	5.06
3	44.27	36.95	58.33	27.13	51.54	31.42
4	29.71	17.91	33.69	8.23	26.9	16.58

WH v DC >	1	2	3	4	5	6	SUM
1	620	587	800	616	841	565	4029
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
SUM	620	587	800	616	841	565	4029
DEMAND	620	587	800	616	841	565	4029

TOTAL -->	$ 53,330.05

Binary	Linking Constraints	Possible Cost	Actual Cost
1	0	$ 2,224	$ 2,224
0	0	$ 2,975	$ -
0	0	$ 2,468	$ -
0	0	$ 2,008	$ -
1			

2. *Right now, we have $1 per unit shipped over the distance between the warehouse and the DC. What happens to our objective function when we increase this to $30? Does your DC assignment change at all?*

Increasing the cost per unit from traveling between the warehouse and the distribution center, the distribution center assignment does not change, because this is still the shorter distances with the lower costs between.

WH v DC >	1	2	3	4	5	6
1	641.1	362.1	279.3	656.7	75.6	528
2	242.1	177.9	819.3	402.3	615.6	151.8
3	1328.1	1108.5	1749.9	813.9	1546.2	942.6
4	891.3	537.3	1010.7	246.9	807	497.4

WH v DC >	1	2	3	4	5	6	SUM
1	0	0	800	0	841	0	1641
2	620	587	0	616	0	565	2388
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
SUM	620	587	800	616	841	565	4029
DEMAND	620	587	800	616	841	565	4029

		TOTAL -->	$ 875,132.70

Binary	Linking Constraints	Possible Cost	Actual Cost
1	-2388	$ 2,224	$ 2,224
1	-1641	$ 2,975	$ 2,975
0	0	$ 2,468	$ -
0	0	$ 2,008	$ -
2			

3. *For distance between each location, we used Manhattan distance but what happens to our model if we use Euclidean distance instead? Did the change impact the model at all? Do you feel this is a better distance metric to use in this scenario?*

When using the Euclidean distance, instead of the Manhattan distance we can see that the minimized cost decreases significantly, because there is a shorter distance between the distribution center and warehouses. The change did impact the model and lowered the overall cost. I feel that this distance metric is better for this scenario because it allows for shorter distances.

WH v DC >	1	2	3	4	5	6
1	18.44963	10.89196	7.678678	15.47876287	2.319526	13.741499
2	6.095318	4.953675	20.06589	9.873201102	18.14153	3.5891225
3	39.492	34.7822	45.90245	25.05415135	39.3002	31.280313
4	22.0367	15.36724	25.77849	6.080008224	19.52623	12.666191

WH v DC >	1	2	3	4	5	6	SUM
1	0	0	800	0	841	0	1641
2	620	587	0	616	0	565	2388
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
SUM	620	587	800	616	841	565	4029
DEMAND	620	587	800	616	841	565	4029

		TOTAL -->	$ 22,890.31

Binary	Linking Constraints	Possible Cost	Actual Cost
1	-2388	$ 2,224	$ 2,224
1	-1641	$ 2,975	$ 2,975
0	0	$ 2,468	$ -
0	0	$ 2,008	$ -
2